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Further additions to the macrolichen mycota of Vietnam

Udeni Jayalal [1], André Aptroot [2], Thi Thuy Nguyen [3], Nguyen Anh Dzung [3], Santosh Joshi [1], Soon-Ok Oh [1] & Jae-Seoun Hur [1*]

[1]*Korean Lichen Research Institute, Sunchon National University, Suncheon-540 742, Korea*
[2]*ABL Herbarium, Gerrit van der Veenstraat 107, NL-3762 XK Soest, The Netherlands*
[3]*Biotechnology Center, Tay Nguyen University, 567 Le Duan, Buon Ma Thuot City, Vietnam*
[*] Correspondence to: *jshur1@sunchon.ac.kr*

Abstract — Seven new records of foliose lichens are reported from Chu Yang Sin National Park of Dak Lak province in Vietnam. Morphological, anatomical and chemical characteristics are described for *Heterodermia obscurata*, *Hypotrachyna flavida*, *Leptogium ulvaceum*, *Parmotrema sancti-angelii, Parmeliella brisbanensis*, *Physma byrsaeum*, and *Sticta marginifera.*

Key words — tropical, macrolichens, *Parmeliaceae*, Da Lat Plateau

Introduction

Although larger organisms are well known in the tropics, the fungi and their lichenized counterparts in tropical forests are less known (Coppins & Wolseley 2002). Aptroot & Sipman (1997) observed that the tropical forest lichens represent about one-third to one-half of the world's lichen diversity. Vietnam, being a moderately large country with the monsoon tropical climate (VARCC 2009), provides a range of conditions to support lichen growth (Nguyen et al. 2010, 2011).

Although the lichen mycota of Vietnam is underworked, recently many species have been reported or described. Aptroot & Sparrius (2006) provided the first checklist of Vietnam lichens, which has been followed by new records of macrolichens by Giao (2009), some findings on foliicolous lichens by Nguyen et al. (2010, 2011), and reports of some *Graphidaceae* species by Joshi et al. (2012).

The Korean Lichen Research Institute (KoLRI) has initiated collaboration with Tay Nguyen University in Vietnam, which has resulted in the collection of many lichen specimens, which have been deposited in the herbarium of the KoLRI. This paper reports seven taxa (in five lichen families) from Chu Yang Sin National Park, Vietnam.

Materials & methods

Chu Yang Sin National Park is located in the central highlands of Vietnam in Krong Bong and Lak Districts of Dak Lak Province. This park is situated within the elevations ranging from less than 600 m to 2442 m at the summit of Mount Chu Yang Sin with the area of 58,947 ha. The Park is the largest protected area on the Da Lat Plateau, in the central highlands (Hughes 2010).

The dominant vegetation type in the Park is broadleaved evergreen forest, covering over 65% of the area. This forest is dominated by the vascular plant families *Fagaceae, Lauraceae, Meliaceae,* and *Illiciaceae* with a canopy height often in excess of 35 m. The high altitudinal range and varied topography gives rise to high vascular plant diversity in different forest types. Montane and submontane forests are at >900 m and lowland semi evergreen forests at <900 m (Hughes 2010).

Morphological and anatomical investigations were performed under a binocular dissecting (NIKON SMZ645) and light microscope (Zeiss Scope. A1). Measurements of all the microscopic features were made on hand-cut thallus and apothecial sections. The sections were examined by mounting in water, 10% KOH, and Lugol's iodine solutions. Ascospore measurements were determined in water. Chemical constituents were identified by spot tests and thin layer chromatography performed in solvent systems A (toluene: dioxin:acetic acid 180:45:5) and C (toluene:acetic acid 85:15) (Orange et al. 2010).

Taxonomic descriptions

Heterodermia obscurata (Nyl.) Trevis., Nuovo Gior. Bot. Ital. 1: 114 (1869) Fig. 1a

Thallus foliose, suborbicular, adnate, 2–6 cm across; lobes narrow, up to 1–2 mm wide, flat; upper surface whitish gray, shiny, epruinose, sorediate; soredia granular, labriform to capitate on lateral and terminal lobes; lower cortex absent; lower surface (medulla) felted with yellowish-brown pigment, K+ purple, marginally rhizinate; rhizines black, simple to squarrosely branched; apothecia not seen.

Chemistry — Cortex K+ (yellow), C–, KC–, P+ (pale yellow); medulla K–, C–, KC–, P–. TLC: atranorin, chloroatranorin, zeorin.

Ecology & Distribution — Found on sandy rock in broad-leaved evergreen forest in Chu Yang Sin National Park. According to Moberg & Nash (2001), this species is growing on tree trunk and mossy rocks in open humid conditions. Mostly cosmopolitan and has been reported from many countries in Africa, Asia, Europe, North America, South America, and Oceania (Aptroot & Feijen 2002, Calvelo & Liberatore 2002, Egea 1996, Eliasaro & Adler 1997, Elix & McCarthy 1998, Fryday et al. 2001, Gowan & Brodo 1988, Hafellner & Türk 2001, Knezevic & Mayrhofer 2009, Kurokawa 1960, Llimona & Hladun 2001, López–Figueiras 1986, Osorio 1992, Singh & Sinha 2010, Sipman 1993, Streimann 1986, Tenorio et al. 2002, Wei 1991).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°27′57.0″N 108°20′34.9″E, elev. c. 780 m, 20.04.2012, S.O. Oh, J.S. Hur VN120185 (KoLRI).

Remarks — *Heterodermia obscurata* (*Physciaceae*) is characterized by its robust appearance, labiate soredia, lack of lower cortex, and the rusty-brown pigmented (K+ purple) lower surface or medulla. According to Moberg & Nash (2001), this species is closely related to *H. speciosa* (Wulfen) Trevis., which differs in having a lower cortex and in lacking yellowish pigmentation. It is also easily confused with *H. japonica* (M. Satô) Swinscow & Krog, which has no lower cortex and which is white to violet.

Hypotrachyna flavida (Zahlbr.) Hale, Smithson. Contr. Bot. 25: 37 (1975) Fig. 1b

Thallus adnate to loosely attached, coriaceous, green, 4–6 cm across; lobes sublinear, separate, 2–4 mm wide, margins eciliate; upper surface greenish grey, emaculate, plane to convex, continuous or irregularly cracked on older lobes; medulla white; lower surface moderately rhizinate; rhizines long, sparsely dichotomously branched, often projecting beyond the lobe margins; apothecia adnate, 1–3 mm in diameter, disc brown, flat to concave; Asci clavate, 8 spored, spores colour less, 6–8 µm; pycnidia not seen.

Chemistry — Cortex K–, C–, KC–, P–; medulla K+ (pale yellowish to brown), C–, KC–, P+ (orange-red). TLC: usnic acid, protocetraric acid.

Ecology & Distribution — Found on a sandy rock in broad-leaved evergreen forest in Chu Yang Sin National Park. Reported as saxicolous species at somewhat higher elevations by Hale (1975). This species has previously been reported from Central and South America (Calvelo & Liberatore 2002, Eliasaro & Adler 1997, Hale 1975, Riddle 1920, Tenorio et al. 2002).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°28′12.3″N 108°20′59.9″E, elev. c. 763 m, 20.04.2012, S.O. Oh, J.S. Hur VN120120 (KoLRI).

Remarks — *Hypotrachyna flavida* (*Parmeliaceae*) is characterized by a saxicolous habit and a medulla containing usnic acid and protocetraric acid. According to Hale (1975), *H. flavida* is fairly restricted to northern South America. Externally, this species very closely resembles *H. protoboliviana* (Hale) Hale, which differs in its corticolous habitat and medulla containing barbatic acid.

Leptogium ulvaceum (Pers.) Vain., Ann. Acad. Sci. Fenn., Ser. A, 15(6): 38 (1921) Fig. 1c

Thallus foliose, loosely adnate, 4–8 cm across, bluish gray; lobes rotund, 2–8 mm wide, homiomerous, margins entire, surface smooth to somewhat rough; isidia, phyllidia absent; lower surface smooth, etomentose, pale bluish with sparse tufted rhizines; apothecia laminal, shortly pedicellate, 0.5–2 mm diam., disc flat to concave, red brown, exciple smooth to wrinkled, cells paraplectenchymatous and continuous to below the hypothecium; ascospores

ellipsoid, muriform, 30–40 × 12–18 µm, apices acute to elongate; pycnidia submarginal; conidia 2–3 µm long.

Chemistry — No chemical detected.

Ecology & Distribution — Found on a sandy rock in a shady place in broad-leaved evergreen forest in Chu Yang Sin National Park. This species has previously been reported from Asia, Europe, South America, and Oceania (Awasthi 1988, Elix & McCarthy 1998, Hafellner 1995, Marcelli 1991).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°26′51.9″N 108°20′18.1″E, elev. c. 816 m, 21.04.2012, S.O. Oh, J.S. Hur VN120170 (KoLRI).

Remarks — *Leptogium ulvaceum* (*Collemataceae*) is characterized by smooth upper surface lacking vegetative propagules. This species is morphologically similar to *L. cochleatum* (Dicks.) P.M. Jørg. & P. James, which differs in its periclinally wrinkled thalline exciple.

Parmeliella brisbanensis (C. Knight) P.M. Jørg. & D.J. Galloway, Flora of Australia, 54: 314 (1992) Fig. 1d

Thallus rosette-forming, orbicular, 5–7 cm across, on a thick, black prothallus projecting 1–2 mm beyond lobe apices, closely appressed to substratum; lobes narrow, 0.6–1 mm wide, discrete at margins, flat; margins entire, somewhat thickened, occasionally ascending; upper surface, slightly maculate, smooth, occasionally striate, grayish when wet, whitish gray when dry, isidiate; isidia delicate, simple to finger-like, to 0.5 mm tall and 0.1 mm thick, laminal and marginal; medulla white to blackish, photobiont *Nostoc*; apothecia, 0.5–2 mm wide, rounded to contorted; exciples thick, thalline, persistent, crenulate-striate, concolorous with thallus; disc flat to concave, red-brown; ascospores simple, ellipsoidal, 10–15 × 8–10 µm; pycnidia not seen

Chemistry — No chemical detected.

Ecology & Distribution — Found on a sandy rock in a shady place in broad-leaved evergreen forest in Chu Yang Sin National Park. According to Jørgensen and Galloway (1992), *Parmeliella brisbanensis* also occurs on tree bark in tropical to subtropical rain forests. This species has been recorded from many countries in the tropics, in Asia, Australia, and Oceania (Elix & McCarthy 1998, Jørgensen & Galloway 1992, Singh & Sinha 2010, Sipman 1993, Wolseley et al. 2002).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°28′04.4″N 108°20′39.0″E, elev. c. 622 m, 20.04.2012, S. O. Oh, J. S. Hur VN120046 (KoLRI).

Remarks: *Parmeliella brisbanensis* (*Pannariaceae*) is characterized by its rosette form, black hypothallus, and finger-like isidiate upper surface. According to Jørgensen & Galloway (1992), this species is the isidiate counterpart of the *P. mariana* (Fr.) P.M. Jørg. & D.J. Galloway complex.

Figure 1: External morphology of Vietnamese lichen specimens (Scale bars = 1 cm). A. *Heterodermia obscurata* VN120185 (KoLRI); B. *Hypotrachyna flavida* VN120120 (KoLRI); C. *Leptogium ulvaceum* VN120170 (KoLRI); D. *Parmeliella brisbanensis* VN120046 (KoLRI); E. *Parmotrema sancti-angelii* VN120288 (KoLRI); F. *Physma byrsaeum* VN120107 (KoLRI); G. *Sticta marginifera* VN120053 (KoLRI).

Parmotrema sancti-angelii (Lynge) Hale, Phytologia 28: 339 (1974) Fig. 1E

Thallus loosely attached to the substratum, up to 6 cm across; lobes rotund, 4–10 mm wide; margins crinate, ciliate; cilia numerous, simple, 2–4 mm long; upper surface pale grey, emaculate, smooth, sorediate; soralia marginal, soredia granular; medulla white, yellowish brown pigments below; lower surface, with

relatively narrow, smooth, erhizinate marginal zone; rhizines sparse, simple; apothecia and pycnidia not seen.

Chemistry — Cortex K+ (yellow), C–, KC–, P–; medulla K– C+ (rose), KC+ (red), P–. TLC: atranorin, chloroatranorin, gyrophoric acid and unknown compound.

Ecology & Distribution — Found on a sandy rock in an open place in broad-leaved evergreen forest in Chu Yang Sin National Park. A common and widespread species in the pantropical region (Elix 1994), it has been reported from Asia, Australia, South America, and Oceania (Calvelo & Liberatore 2002, Divakar & Upreti 2005, Elix 1994, Elix & McCarthy 1998, Elix & Schumm 2001, Hale 1974, Kurokawa 1993, Wei 1991, Wolseley et al 2002).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°28′04.4″N 108°20′39.0″E, elev. c. 622 m, 20.04.2012, S.O. Oh, J.S. Hur-VN120288 (KoLRI).

Remarks — *Parmotrema sancti-angelii* (*Parmeliaceae*) is characterized by an emaculate upper surface, sorediate margins, yellowish lower medulla, and brown to black lower surface. This species is very close to *P. indicum* Hale, which differs in having norlobaridone and in lacking pigmentation on the lower medulla.

Physma byrsaeum (Ach.) Tuck., Syn. N. Amer. Lich. 1: 115 (1882) Fig. 1f

Thallus foliose, rosulate, adnate, 6–8 cm across, 200–350 µm thick; lobes radiating, oblong 1–5 mm wide; margins entire, thickened, re-curved at the lobes end; upper surface ridged, somewhat wrinkled, brownish black, lacking isidia; cortex thin, photobiont *Nostoc*; lower surface pale brown, rhizinate; rhizines of interwoven hyphae forming a cushion-like indumentum, whitish to black; ascomata apothecial, abundant, laminal, sessile, 1–4 mm wide; disc concave to plane, reddish brown; thalline exciple thick, wrinkled, lobed, concolorous with thallus; ascospores simple, ellipsoidal, 12–15 × 10–12 µm; episporium, 2–3 µm thick; pycnidia laminal, conidia 2–3 µm long.

Chemistry — No chemicals detected.

Ecology & Distribution — Found on sandy rock in a shady place in broad-leaved evergreen forest in Chu Yang Sin National Park. *Physma byrsaeum* has been reported from many countries in the paleotropics, including Asia, Australia, Central America, and Oceania (Aptroot & Seaward 1999, Aptroot & Sipman 1991, Elix & McCarthy 1998, Sipman 1993, Tenorio et al. 2002, Verdon 1992, Wolseley et al. 2002).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°28′12.3″N 108°20′59.9″E, elev. c. 763 m, 20.04.2012, S.O. Oh, J.S. Hur VN120107 (KoLRI).

Remarks — *Physma byrsaeum* (*Collemataceae*) is characterized by a well-developed cortical layer and wrinkled thalline apothecial exciple. This species

is morphologically similar to *P. pseudoisidiatum* Aptroot & Sipman, which is isidiate.

Sticta marginifera Mont., Annls Sci. Nat., Bot., Sér. 2 18: 265 (1842) Fig. 1G

Thallus palmate to irregularly branched in clumps, 1–2 cm across, arising from a rooted holdfast; lobes flabellate to irregularly dichotomously branching, 1–3 mm wide, proliferating round to oblong lobules attached to primary lobes by thin terete stalks; margins entire or irregularly notched, thickened below; upper surface grayish glaucous when dry, dark blue-black when wet, thin, papery, smooth, rather fragile, isidiate, phyllidiate and minutely maculate; isidia marginal, sometimes on the upper surface, styliform to coralloid, to 0.5 mm tall; phyllidia marginal, developing from isidia, to 1 mm tall, irregularly lobed; photobiont *Nostoc*; lower surface white to pale at margins, brown centrally, minutely pubescent; cyphellae scattered, round, to 0.5 mm diam.; pit membrane white; apothecia not seen.

Chemistry — No chemicals detected.

Ecology & Distribution — Found on sandy rock in a shady place in broad-leaved evergreen forest in Chu Yang Sin National Park. According to Galloway (2001), *Sticta marginifera* prefers humid, deeply shaded habitats in montane rain forests on different substrates. This species has been recorded from Asia, Australia, South America, and Oceania (Awasthi 2007, Calvelo & Liberatore 2002, Elix & McCarthy 1998, Galloway 2001, Streimann 1986).

Specimen examined: **VIETNAM. Dak lak province:** Chu Yang Sin National Park, on rock, 12°28′04.4″N 108°20′39.0″E, elev. c. 622 m, 20.04.2012, S.O. Oh, J.S. Hur VN120053 (KoLRI).

Remarks — *Sticta marginifera* (*Lobariaceae*) is characterized by the presence of secondary lobules and the coralloid isidia. According to Galloway (2001), the similar *S. brevipes* (Müll. Arg.) Zahlbr. also has similar flabellate lobes with thickened and revolute apices but does not produce secondary lobules.

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